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Megaselia dilatimana Disney, 2006 and *Megaselia falloconsueta* Disney, 2006, two Afrotropical species of scuttle flies (Diptera, Phoridae) newly recorded from Peninsular Malaysia

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Abstract

Megaselia dilatimana Disney, 2006 and *M. falloconsueta* Disney, 2006 (Diptera, Phoridae), two species of scuttle flies previously only known from Afrotropical region, are reported for the first time from Peninsular Malaysia. These species were collected from July to September 2020 during surveys of saprophagous scuttle flies at selected locations in the states of Selangor, Negeri Sembilan, and Johor. The geographical distribution of these species is extended to the Oriental region and increases the number of species of *Megaselia* known from Peninsular Malaysia to 36.

Keywords

Biodiversity, distribution, Johor, Negeri Sembilan, Oriental region, saprophagous, Selangor

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Introduction

Scuttle flies (Diptera, Phoridae) are a group of taxonomically rich small files which have been used as indicators of biological diversity due to their broad spectrum of morphology and ecological traits (Disney 1994; Disney and Durska 2008; Brown 2010; García-Romera and Barrientos 2017). In Phoridae, *Megaselia* Rondani, 1856 is the largest genus and composed of approximately 1,600 species (Fang and Liu 2015). The larval habits of *Megaselia* species include predators, parasites, parasitoids, fungus feeders, plant seeders, and decomposers of organic matter, including vertebrates and invertebrates (Disney 1994; Skevington and Dang 2002). Studies have found that this genus occurs in different types of habitats (Durska et al. 2005; Durska 2009) and, interestingly, species of *Megaselia* are also found in diverse urban environments (Hartop et al. 2015, 2016; Brown and Hartop 2017).

However, in Malaysia, the genus *Megaselia* is still insufficiently studied. The baseline for knowledge of *Megaselia* species from Peninsular Malaysia (West Malaysia) relies only on the lists of Indo-Australian

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phorids by Borgmeier (1966, 1967), which feature 10 species, including those recorded from Sarawak of Malaysian Borneo (East Malaysia). Additional records since the publications of Borgmeier (1966, 1967) bring the number of species to 34 (Disney and Schroth 1989; Disney 1991a, 1993, 1995a, 1995b; Disney et al. 1998; Disney and Maschwitz 2000; Gori 2014; Zuha and Disney 2018); these additional species of *Megaselia* mainly comprise novel species, including species of forensic importance (Thevan et al. 2010).

In the current study, we report new occurrences of two *Megaselia* species, which were previously thought to be limited to the Afrotropical region. *Megaselia dilatimana* and *M. falloconsueta* were collected from central Peninsular Malaysia in the state of Selangor and in the southern region of the states of Negeri Sembilan and Johor.

Methods

Pan traps with bait were used to collect scuttle flies (Disney 1994; Tan et al. 2012). To lure scuttle flies into the trap, an approximately 20 g piece of decomposing beef liver was placed in a cylindrical plastic container and covered with 2 × 2 mm wire mesh. The baited container was placed at the centre of a 17 × 25 cm white plastic pan which was subsequently filled with tap water mixed with 2 or 3 drops of liquid detergent. Traps were placed for a duration of 3 days at following locations: A) Batu Caves Lake Garden, Gombak, Selangor (03°14′53″N, 101°42′13″E, 100 m alt.); B) Forensic Science Simulation Site, Universiti Kebangsaan Malaysia, Bangi, Selangor (02°54′45″N, 101°47′20″E, 40 m alt.); C) Jade Image Agricultural Park, Kuala Pilah, Negeri Sembilan (02°40′50″N, 102°16′34″E, 180 m alt.), and D) Taman Setia Indah Public Park, Johor Bahru, Johor (01°34′13″N, 103°45′25″E, 50 m alt.) (Fig. 1). Scuttle flies trapped in the water were preserved in 70% ethanol. In laboratory, the scuttle flies were dissected and mounted in Berlese fluid on microscope slides and capped with 6 mm round cover slips (Disney 2001). Taxonomic characters of the adult scuttle flies were based on Disney (1994), and they were obtained by using 12-megapixel digital camera (Toupcam, China) attached to SMZ745T trinocular stereomicroscope (Nikon, Japan). Specimens were registered with a voucher numbers and deposited in the Centre for Insect Systematics, Faculty of Science & Technology, Universiti Kebangsaan Malaysia (CISUKM).

Results

Megaselia dilatimana Disney, 2006

Megaselia dilatimana Disney 2006a: 5.

New records. PENINSULAR MALAYSIA – **Selangor** • Bangi, Universiti Kebangsaan Malaysia; 02°54′45″N,

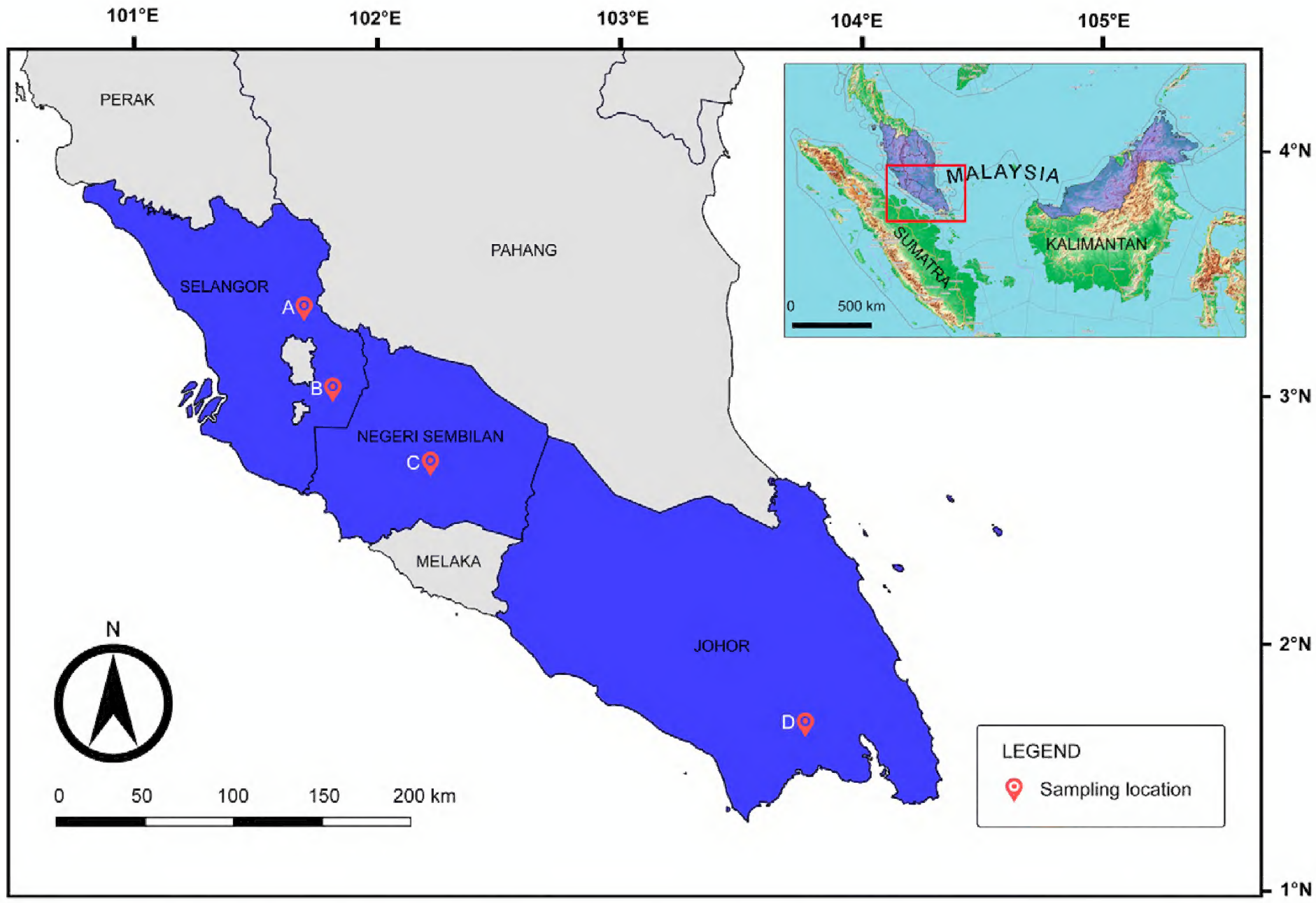

Figure 1. The locations of newly recorded *M. dilatimana* and *M. falloconsueta* from Peninsular Malaysia (inset). Selangor: A. Batu Caves Lake Garden, Gombak. B. Forensic Science Simulation Site, Universiti Kebangsaan Malaysia, Bangi; Negeri Sembilan: C. Jade Image Agricultural Park, Kuala Pilah; Johor: D. Taman Setia Indah Public Park, Johor Bahru.

101°47′20″E; 40 m alt.; 03.VIII.2020; R.M. Zuha leg.; water trap; 2♂, preserved on microscope slides, CISUKM Me2020113 – **Johor** • Johor Bahru, Taman Setia Indah Park; 01°34′13″N, 103°45′25″E; 50 m alt.; 20.IX.2020; N. Gnanaprakasam leg.; water trap; 1♂ and 1♀, preserved on microscope slides, CISUKM Me2020091.

Identification. According to the key by Borgmeier (1966), this species belongs to Group III with following characters: scutellum with 2 bristles, mesopleuron with hairs and 1 or more bristles and short costa (costal index ≤0.43). The key leads to *M. sodalis* (Brues, 1905) and *M. turbulenta* Brues, 1936, which have equal supra-antennal bristles, differing from our specimens that have subequal supra-antennal bristles with upper pairs being more robust. Based on Borgmeier (1966), species with unequal supra-antennal bristles are *M. turgipes* Borgmeier, 1966 and *M. brevineura* Brues, 1936, but we rule out the latter because its front basitarsus not as broad as tibia. Our specimens have the front basitarsus and tibia of equal breadth, and the antials are slightly higher than upper supra-antennal bristles, which distinguish our specimens from *M. turgipes*. *Megaselia dilatimana* was identified based on the combination of the following diagnostic characters (Disney 2006a, 2009a): mesopleuron hairy, with at least 1 differentiated bristle on rear margin and 3 notopleural bristles. Scutellum with 2 hairs in front of 2 scutellar bristles. Costa not thickened, less than half of wing length. Vein 3 forked. Venter brown. Front basitarsus thickened with one row of hairs of ventral face reduced to short blunt spinules. Tarsal segment 5 slightly longer than 4. Anal tube short. Hairs of proctiger stronger and longer than those on cerci. Left lobe of hypandrium well developed. In females, the wing membrane is said to be colourless in the key by Borgmeier (1966), but in our specimens it is brownish grey.

Male. Frons dark brown, 0.24 mm wide and 0.22 mm long. Bristles on frons as Figure 2A. Supra-antennal bristles subequal in length but upper pair more robust and lower pair thinner. Antials closer to the compound eyes and almost vertically below anterolateral bristles. Preocellar bristles closer to median furrow and lower than the mediolateral bristles. Microsetae fine but dense with 102–117 hairs, divided by the median furrow. Cheek with 3 bristles, and jowls with 2 longer bristles. Postpedicels subglobose, greatest breadth about 0.11 mm and brown. Subcuticular pit sensilla (SPS) vesicles absent. Arista brown. Palps straw-yellow, thin, about the same length as the widest breadth of postpedicels with 6 or 7 bristles and 5–8 hairs. Labrum straw-yellow, about two-thirds as wide as postpedicels. Labella also straw-yellow but slightly wider than postpedicels, 5 or 6 pseudotracheae, 10–18 spinules, 10–12 longer hairs on lower face. Thorax brown. Mesopleuron with 13–18 hairs with 3 differentiated bristles at posterior margin. Three notopleural brisles and no cleft in front of these. Scutellum with a pair of bristles and anterior pair of hairs. Propleuron with a bristle on upper margin and 2 bristles on lower margin. Abdominal tergites brown with scattered fine hairs on the posterior half of each tergite. Hairs on tergite 6 only slightly longer than the rest. Venter brownish with scattered hairs below segments 5 and 6. Hypopygium as Figure 2B. Epandrium brown with 9 or 10 hairs on left face. A single differentiated hair on the lower part of epandrium. Right lobe vestigial. Anal tube pale brown and slightly longer than epandrium. Hypandrium slightly paler, tapered and coated with hairs. Legs straw-yellow in most part, but brown on mid coxa. Hind femora and tibiae brown, but slightly tinged brown on fore and mid femur and tibiae. Fore tibia and tarsus as Figure 2C, with posterodorsal palisade on tarsal segments 1–4. Dorsal hair palisade of mid tibia about 0.6–0.7× from its length. Hairs below basal half of hind femur longer than those of anteroventral row of outer half. Hind tibia with 9 or 10 differentiated posterodorsal hairs. Spinules of apical combs normal, not bifurcate. Wings 0.9–1.0 mm long (Fig. 2D). Costal index 0.38–0.39. Costal ratios 3.69–4.20:0.67–1.02:1. Costal cilia of section 3 about 0.04 mm long. Minute hair at base of vein 3 absent, with 2 axillary bristles, the outer being 0.06–0.07 mm long. Thick and thin veins yellowish brown except vein 7 and subcostal vein obscure. Membrane lightly tinged grey. Haltere brown.

Female. Bristles orientation on frons similar to male except preocellar almost level with mediolateral bristles. Cheek with 5 or 6 bristles and jowls with 2 longer bristles. Postpedicels similar to male, approximately 0.1 mm wide, without SPS vesicles. Palps with 6 or 7 apical bristles and 7 or 8 hairs. Labrum straw yellow, about as wide as postpedicels. Labella also straw-yellow and wider than postpedicels, with 4 pseudotracheae, 16 spinules, 10–12 longer hairs on lower face. Thorax similar to male. Abdominal tergites brown, with short scattered fine hairs on tergites 2–6, with hairs on hind margin of tergites 4–6 only slightly longer. Tergite 6 as Figure 2E. Venter brown with scattered, minute hairs on segments 3–6. Epiproct with 3 long posterior hairs and 2 shorter anterior hairs. Cerci pale with 4 or 5 long hairs. Dufour's crop mechanism about 0.19 mm long and 0.07 mm wide, as Figure 2F. Legs similar to male. Wings as male, except approximately 1.4 mm long. Costal index 0.41. Costal ratios 1.7:0.46:1. Costal cilia of section 3 about 0.06 mm long. Minute hair at base of vein 3 present, with 2 axillary bristles, the outer being 0.9 mm. Thick and thin veins yellowish brown, except vein 7 and subcostal vein very obscure. Membrane lightly tinged grey. Haltere brown.

Megaselia falloconsueta Disney, 2006

Megaselia falloconsueta Disney 2006b: 120.

New records. PENINSULAR MALAYSIA – **Selangor** • Gombak, Batu Caves Lake Garden; 03°14′53″N, 101°42′13″E; 100 m alt.; 02.IX.2020; N. Naqib leg.; water trap; 4♂ and 3♀, preserved on microscope slide, CISUKM Me2020035 – **Johor** • Johor Bahru, Taman Setia Indah Park; 01°34′13″N, 103°45′25″E; 50 m alt.; 20.IX.2020; N. Gnanaprakasam leg.; water trap; 2♀, preserved on microscope slide, CISUKM Me2020095.

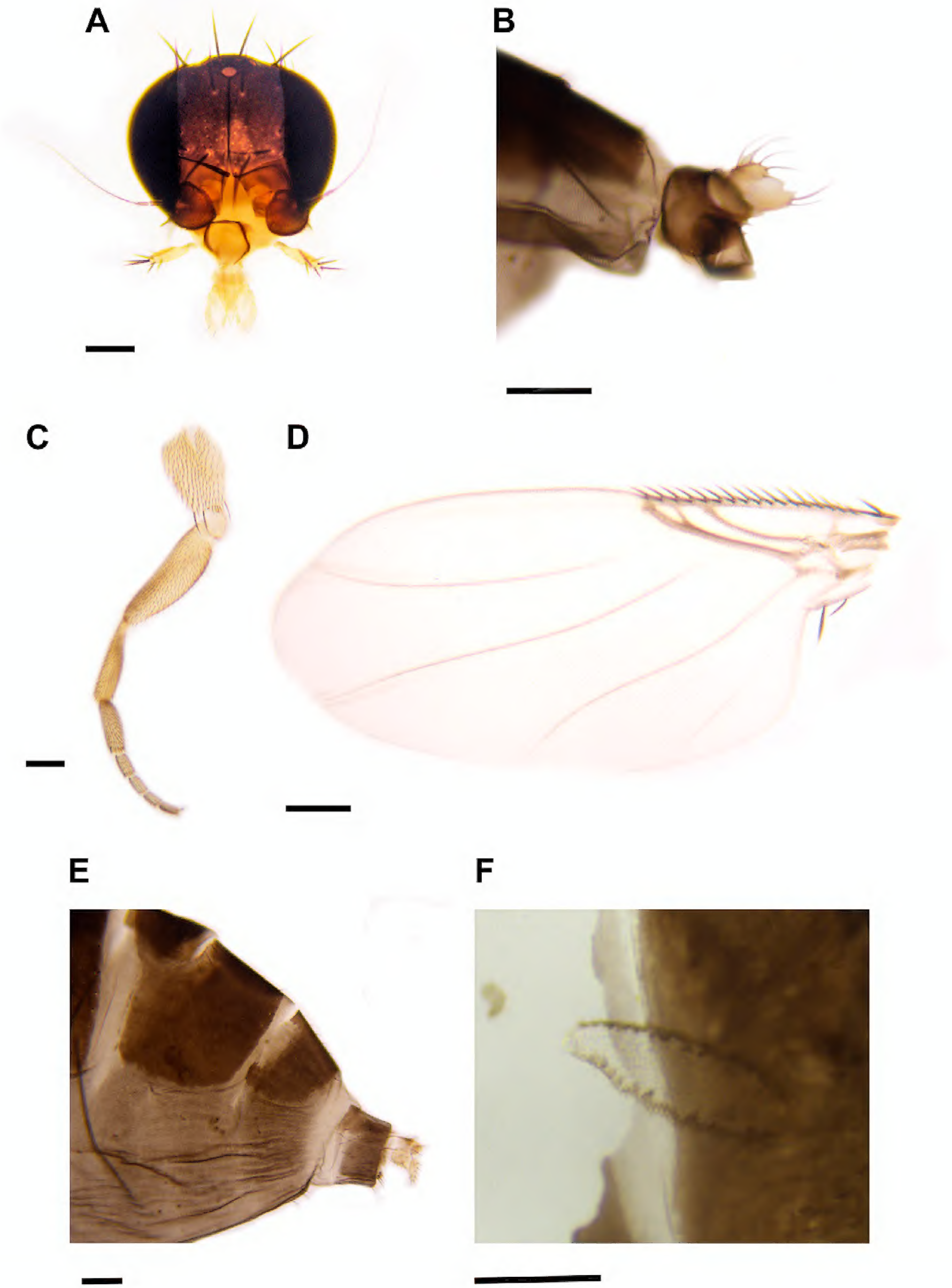

Figure 2. *Megaselia dilatimana*. **A.** Head of male, frontal view. **B.** Male hypopygium, left lateral view. **C.** Fore tibia and tarsus of left leg, posterior view. **D.** Left wing of male, dorsal view. **E.** Abdominal tergites 5–7 and terminal segments of female, left lateral view. **F.** Dufour's crop mechanism of female partially covered by abdominal tergite 3. Scale bar = 100 μm.

– **Negeri Sembilan** • Kuala Pilah, Jade Image Agricultural Park; 02°40′50″N, 102°16′34″E; 180 m alt.; 26.X.2020; J.L. Yap leg.; water trap; 1♀, preserved on microscope slide, CISUKM Me2020121.

Identification. In the key by Borgmeier (1967), our specimens key out to Group VII, which has the following characters: scutellum with 2 bristles, mesopleuron bare, costa long (costal index ≥0.44). The specimens

key out in Borgmeier's key to couplet 28, which distinguishes between the differing conditions of female tergites. *Megaselia falloconsueta* was identified based on the combination of the following diagnostic characters (Disney 2006b; Disney 2009a): vein 3 forked, no hair at base of vein 3, costa at least half wing length, and subcostal vein reaching R1. Mesopleuron bare with 2 notopleural bristles. Hind femur yellow, apart from brown tip. Some spinules of apical comb of posterior face of hind tibia bifurcate, and mid tarsal segment 5 shorter than 4. In males, right paraphysis lack projection. In females, the sixth tergite divided in the middle and sternum 8 with a finger-like process from posterior. Abdominal sternite 7 with a strongly sclerotized anterior point and long hairs at hind margin. No sclerotized furca.

According to Disney (2006b), *M. falloconsueta* belongs to the *M. consueta* (Collin, 1912) species complex, which also includes *M. dawahi* Disney, 2006 and *M. harteni* (Disney, 1991b). The characters of hypopygium in males of *M. falloconsueta* differ from the three species most closely resembling it in lacking a process on the right paraphysis. The tip of the right paraphysis in *M. consueta*, *M. dawahi*, and *M. harteni* clearly more downwardly projecting, but in these species, all other characters bear similarities to *M. falloconsueta*. Females of *M. falloconsueta* can be distinguished from *M. consueta* and *M. harteni* in having a more sclerotized tip of sternite 7 and in lacking a sclerotized furca (Disney 2006b). The sclerotized furca and shape of abdominal tergites in *M. dawahi* are diagnostic and clearly distinguishable from *M. falloconsueta*.

Male. Frons yellow with tinge brown, 0.20–0.23 mm wide and 0.15–0.21 mm long. Bristles on frons as Figure 3A. Supra-antennal bristles extremely unequal with the upper pair longer and thicker than lower pair. Antials lower and a little closer to upper supra-antennal than anterolateral bristles. Preocellar bristles further apart than upper supra-antennals and about the same level as mediolateral bristles. Microsetae fine but dense with 57–60 hairs, divided by the median furrow. Cheek with a row of 3 bristles and jowls with 2 longer bristles. Postpedicels subglobose, greatest breadth about 0.08–0.11 mm and straw yellow clothed with black hairs. SPS vesicles present, 7–10, irregularly shaped, mostly distributed in the mid-section of postpedicel. Arista brown. Palps straw-yellow, with 5 bristles and 3 or 4 hairs. Labrum straw-yellow, about two-thirds as wide as postpedicels. Labella also straw-yellow about as wide as postpedicels, 4 pseudotracheae, 6 or 7 spinules, 10–12 longer hairs on lower face. Thorax yellowish brown with slightly darker bands on top. Mesopleuron bare. Two notopleural bristles and no cleft in front of these. Hairs between notopleuron and supra-alar bristles differentiated, almost bristle-like. Scutellum with a pair of bristles and anterior pair of hairs shorter than hairs at posterior margin of scutum. Propleuron with 2 hairs on upper margin and 2 bristles on lower margin. Abdominal tergites brown and straw-yellow, but tergite 1 paler. Tergite 2 straw-yellow on anterior half with longer hairs. Tergites 5 and 6 mostly straw-yellow. Hairs are more scattered on tergites 2–4 but longer on tergite 6. Venter straw-yellow with scattered hairs below segments 4–6. Hypopygium brown, with yellowish brown anal tube (Fig. 3B). Left lobe of hypopygium with 9 or 10 hairs and 1 longer hair. Right lobe of hypopygium rounded in the posterior margin, also with 9 or 10 hairs and 1 longer hair. Legs straw-yellow, except brown on the tip of hind femur and mid coxa. Fore tarsus with complete posterodorsal hair palisadae on all segments and tarsal segment 5 slightly longer than segment 4. Dorsal hair palisade of mid tibia about 0.8× from its length. Hairs below basal half of hind femur slightly longer than those of anteroventral row of outer half. Hind tibia with 7–9 differentiated posterodorsal hairs. Spinules of apical combs bifurcate (Fig. 3C). Wing 0.88–1.48 mm long (Fig. 3D). Costal index 0.51–0.56. Costal ratios 3.26–4.49:3.49–5.55:1. Costal cilia of section 3, 0.04–0.05 mm long. No hair at base of vein 3, with 3 axillary bristles, the outer being 0.04–0.06 mm. Thick and thin veins brownish yellow and subcostal vein reaching R1. Membrane lightly tinged yellow. Haltere brown.

Female. Frons yellow, about as wide as long. Bristles on frons similar to male. Postpedicels subglobose, greatest breadth about 0.09–0.11 mm, and straw-yellow, clothed with black hairs. SPS vesicles present, 7–10 considerably large and irregularly shaped, but mostly obscure. Palps straw yellow with 6 bristles and 9–11 hairs. Labrum almost as wide as the diameter of postpedicel. Labella wider than postpedicels, 4 pseudotracheae, 20–24 spinules, 10–12 longer hairs on lower face. Thorax similar to male, except propleuron with 2–5 hairs on upper margin and 2 bristles on lower margin. Abdominal tergites mostly brown with yellowish patches (Fig. 3E). Tergite 2 brown and with hairs on lateral and posterior margin. Tergite 3 and 4 broader posteriorly with scattered hairs. Hairs scattered on tergites 5 and 6, but longer on tergite 6. Tergite 7 subrectangular posteriorly with hairs longer than those on hind of tergite 6. Venter yellowish grey with scattered hairs below segment 3–6, and hairs on segment 6 longer than the rest. Tip of sternite 7 slightly sclerotized and post lateral lobes at rear of sternum 8 with tuft and 5 or 6 elongated hairs. Cerci pale yellow. Furca very obscure. Dufour's crop mechanism about 0.23–0.27 mm long and 0.17–0.20 mm wide, convex posteriorly (Fig. 3F). Legs as male. Wing as male, but 1.5–2.0 mm long. Costal index 0.55–0.57. Costal ratios 4.08–4.28:4.59–5.07:1. Costal cilia of section 3, 0.04–0.05 mm long. No hair at base of vein 3, with 3 axillary bristles, the outer being 0.07–0.09 mm. Haltere brown as male.

Discussion

Megaselia dilatimana has been previously recorded from Silhouette Island, Seychelles, to Picard Island, part of Aldabra Atoll, and from Oman to United Arab Emirates (Disney 2006a, 2008). *Megaselia falloconsueta*

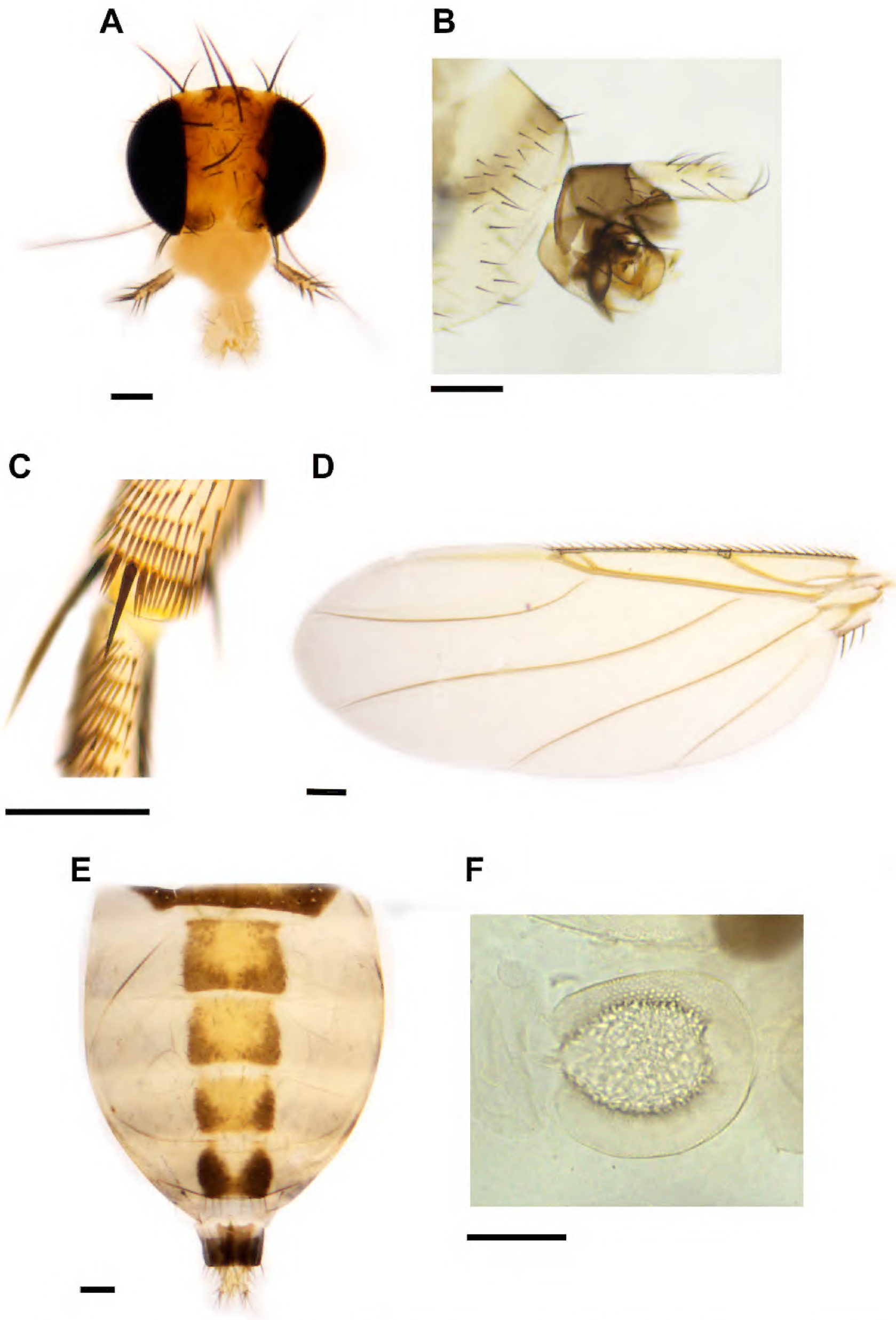

Figure 3. *Megaselia falloconsueta*. **A.** Head of male, frontal view. **B.** Male hypopygium, left lateral view. **C.** Spinules of apical combs left leg of male, posterior view. **D.** Left wing of male, dorsal view. **E.** Abdominal tergites 2–7 and terminal segments of female, dorsal view. **F.** Dufour's crop mechanism of female. Scale bar = 100 µm.

was thought to be restricted to the Seychelles (Disney 2006b). These two species are among the 418 species of phorids known from the Afrotropical region, but there are at least 3000 species yet undescribed (Kirk-Spriggs and Stuckenberg 2009). The taxonomy of Afrotropical phorids were first described by Collin (1912), updated by Beyer (1965), and critically supplemented by more recent publications of Disney (2005, 2006a, 2006b, 2006c,

2006d, 2006e, 2007, 2008, 2009a, 2009b), Disney et al. (2013), and Mostovski (2015).

Our new data expand the distribution of *M. dilatimana* and *M. falloconsueta* from the Afrotropical Region to the central Oriental Region and increases the number of *Megaselia* species in Peninsular Malaysia to 36 species. The discovery of *M. falloconsueta* potentially may help to elucidate the taxonomic difficulties within the *M. falloconsueta* species complex (Disney 2006b), provided additional sibling species are found in this region. The biology of these two species remains unknown. Although the frequency of *M. dilatimana* and *M. falloconsueta* collected from baited traps were considerably low, the use of this technique in the future may provide insight into their larval ecology and habitat, which are largely saprophagous in Phoridae (Disney 1994).

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Authors' Contributions

Conceptualization: RMZ, RHLD. Data curation: RMZ. Formal analysis: RMZ, RHLD. Funding acquisition: RMZ. Investigation: RMZ, NG, NN, JLY. Methodology: NG, NN, JLY. Project administration: RMZ. Writing – original draft: RMZ. Writing – review and editing: RHLD.

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